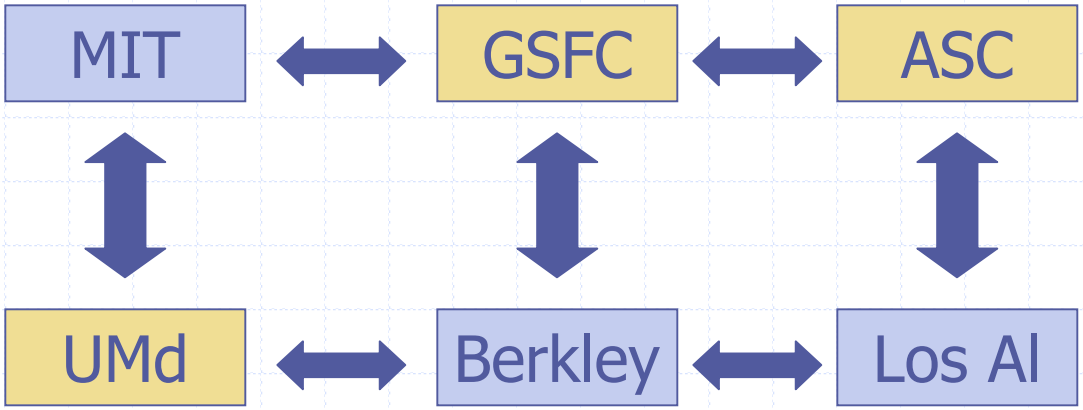
The Virtual Heliospheric Observatory and Distributed Data Processing

T.W. Narock[1,2], A. Szabo[2], A. Davis[3]
tom.narock@gsfc.nasa.gov

1. L3 Communications, GSI
2. NASA/Goddard Space Flight Center
3. ACE Science Center, Caltech

Foundations of the Virtual Heliospheric Observatory (VHO)

Data Synchronization



GSFC – Goddard Space Flight Center – WIND MFI Data

MIT – Massachusetts Institute of Technology – WIND SWE Data

UMd – University of Maryland, College Park – SOHO Celias Data

Berkley – University of California, Berkeley – WIND 3DP Data

ASC – ACE Science Center, California Institute of Technology – ACE MAG and SWEPAM Data

Los Al – Los Alamos National Laboratory – Genesis Data

Data is synchronized autonomously among all participating data providers using Rsync software

Implemented

In process of being implemented

Foundations of the Virtual Heliospheric Observatory (VHO)

Data Synchronization (Continued)

Benefits to the Community

1.) Allows creation of new data products

- example: Merged WIND MFI and SWE data

http://lepmfi.gsfc.nasa.gov/plots.html

2.) Principle investigators can use other data sets to calibrate their own instruments thus providing higher quality data

VHO Prototype - Requirements

3.) Data Providers should provide metadata which is searchable and provide means to retrieve data

1.) Must provide the user with an easy to use interface that can query multiple data sets simultaneously

Middleware

2.) The user need not know the data set or how it is described

Data Provider 1

Data Provider 2

Services

Heliosoft

4.) Provide processing services as well as software libraries for the analysis and display of data

VHO Prototype - Design

A Prototype VHO was developed at GSFC

- Being tested at GSFC to later be deployed nationally

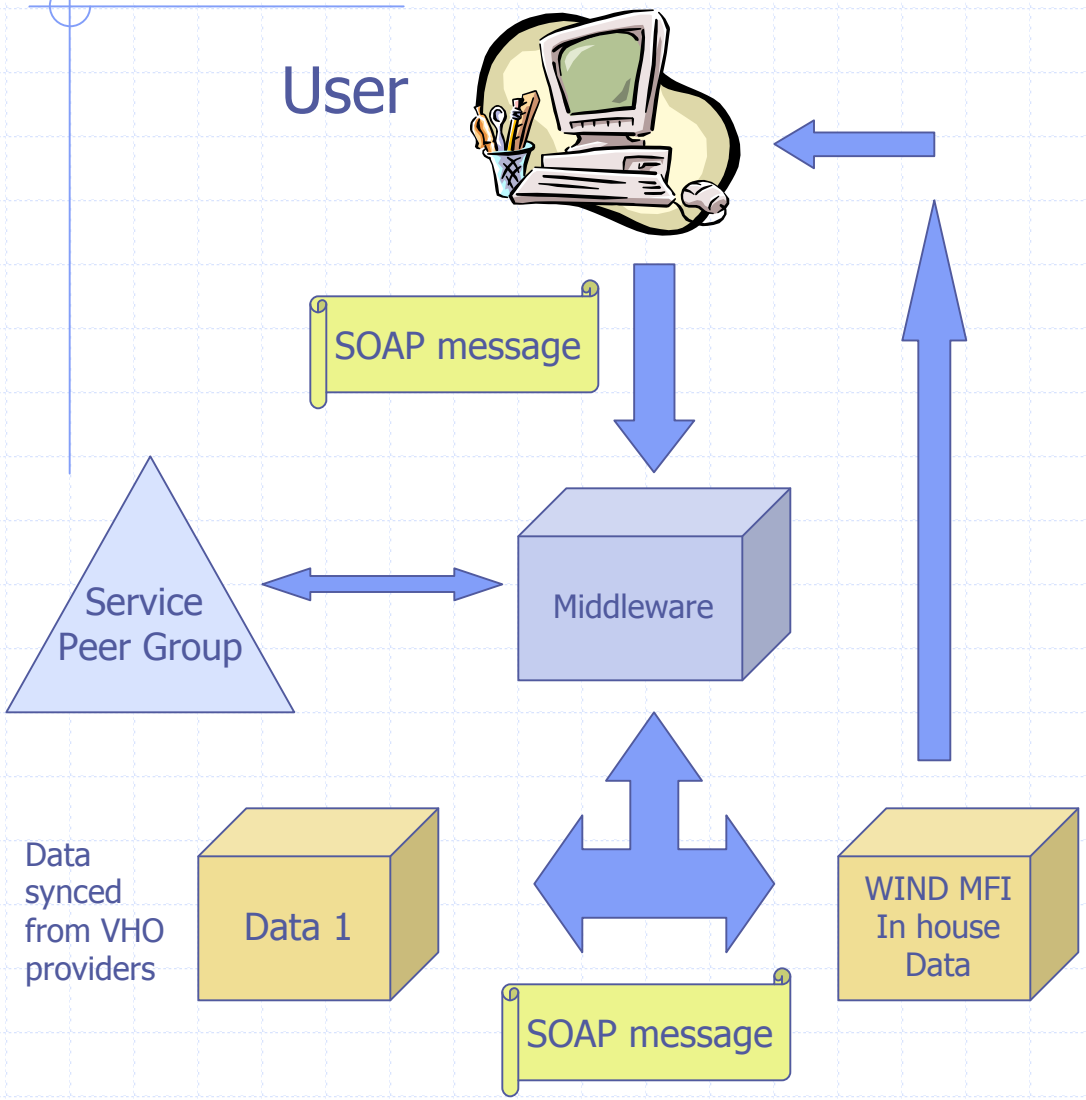
- It utilizes all datasets which are currently synced to GSFC and provides access to most recent data

- Provides one interface to many data sets, via web access or stand alone program

- Provides search and retrieval capabilities for Heliospheric data, allows searches by date, instrument and/or spacecraft position

- Lays the foundations for services and presently provides first service - coordinate transformations

VHO Prototype - Design (cont.)



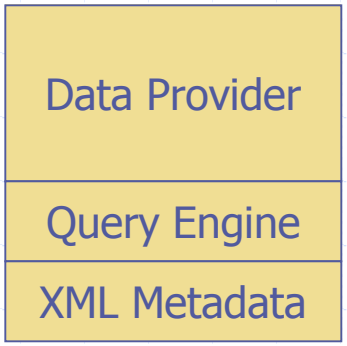
Users communicate with middleware via SOAP messages or web interface.

Middleware distributes the query to data providers.

Users then obtain data directly from data provider.

Or service peer group can provide processing prior to download

Prototype Queries



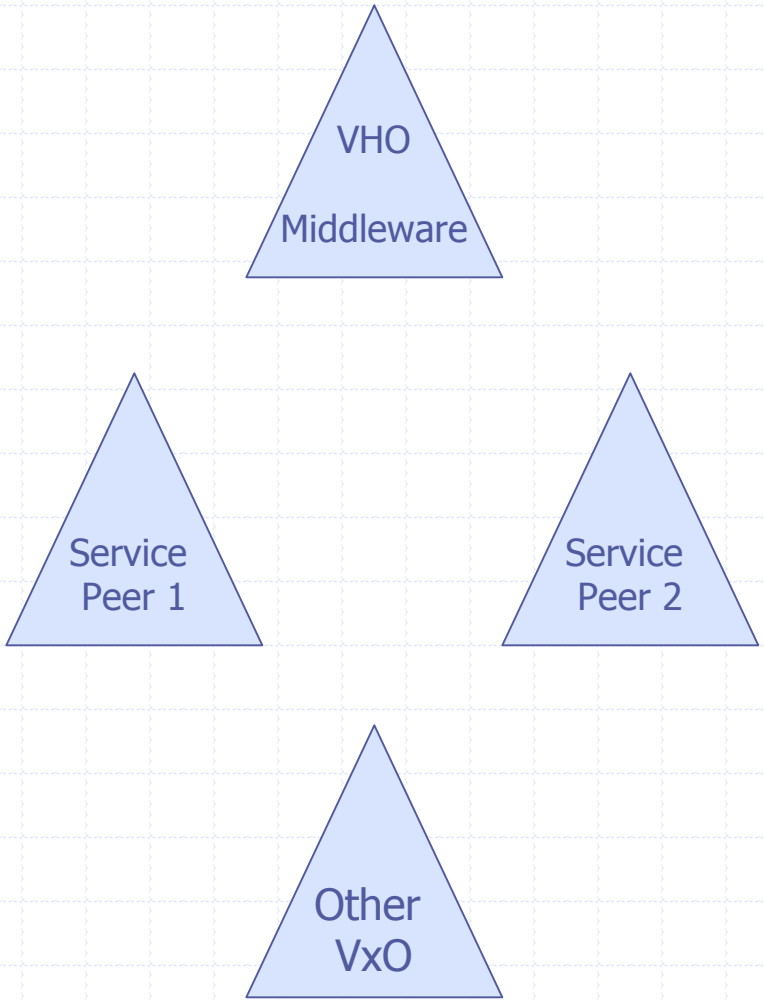
- Query Engine sits on Data Provider and listens for incoming SOAP messages.
- Search Parameters are removed from message and metadata is searched
- XML metadata consists of one metadata file for each data file. Files are small and contain date and min/max values of spacecraft orbit over the time period covered by the corresponding data file
- An advanced search was implemented using higher level science terms such as searching for "L1 data", "solar wind data" or "inner heliosphere data"

Services

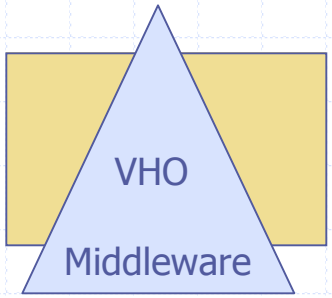
- Search and retrieval can only go so far
- Users need more than access to data
- Services will provide commonly used processing capabilities
- They will save the community time and effort and provide data in a form ready for use

Services – Design

- Designed as a peer-to-peer network
- Services are more dynamic than data providers
- Multiple peers may offer similar services
- VxOs can join peer group and use services (VHO Middleware is a peer)
- Peer group is closed, i.e. must be approved user to contribute services



Services - Implementation



- VHO middleware understands SOAP messages and is also a peer in the service peer group
- Allows VHO middleware to quickly and easily find and use services
- Users need not learn another interface. To request a service they communicate with middleware using SOAP as they would if they were sending a data request (only inputs in SOAP message change slightly)
- Additionally, some common services will also have a web interface for easy use by non-programmers

Services – Technical

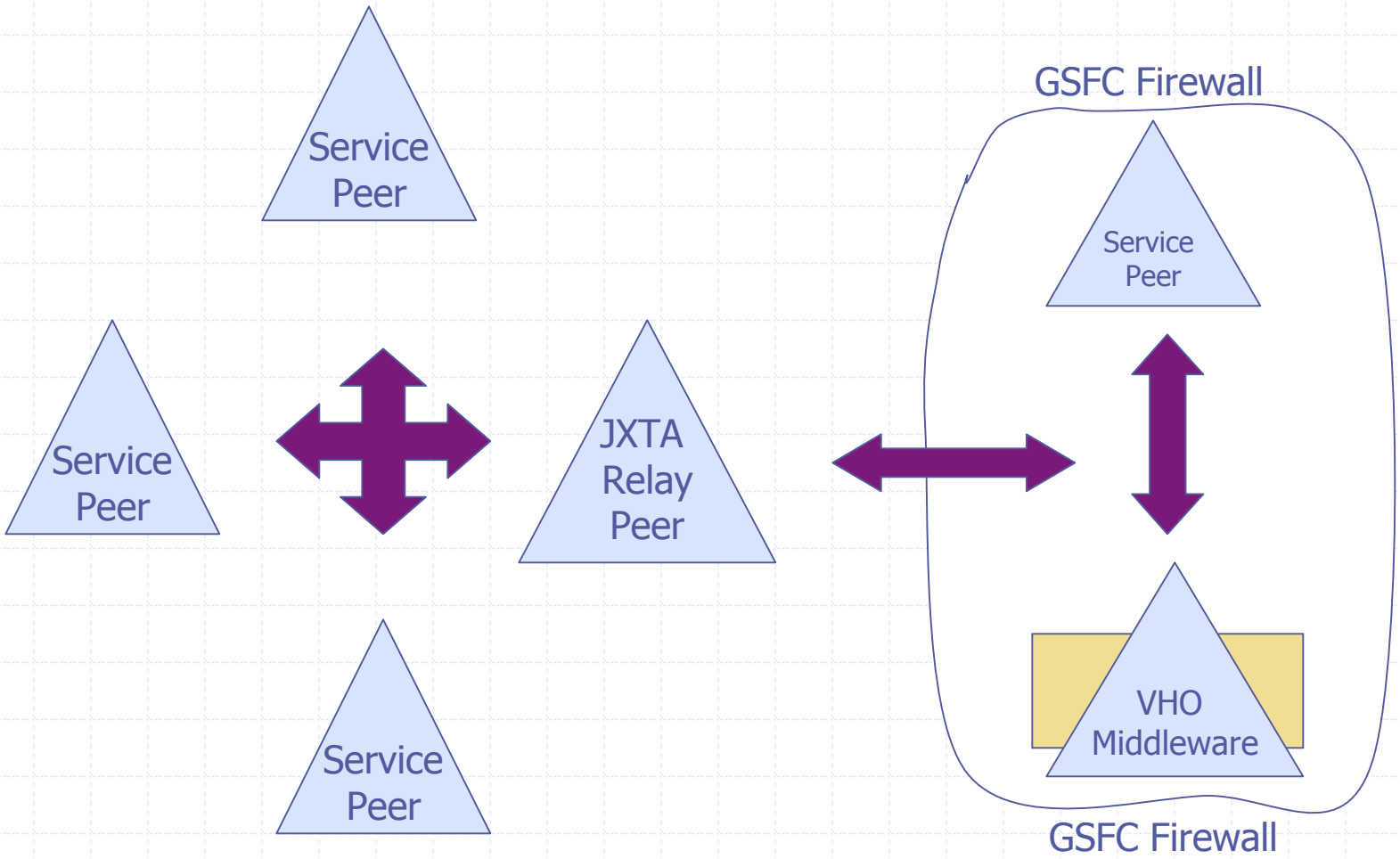
- Service Peer Group Implemented using Sun's JXTA Protocols

- JXTA allows peers to communicate directly and share resources even though some peers are behind firewalls or using different network transports

- Service Peers retrieve data on their own or by using VHO

- First service obtains data through direct access using APIs developed by ACE Science Center

Services – Layout



Why not have it all P2P?

- JXTA does not guarantee messages will arrive or be responded to

- Requires an all Java implementation and forces users to implement their own VxO software in Java with extensive JXTA

- New JXTA releases are frequent and some have been found to worse in performance
[Seigneur et. al., ACM International Conference 2003]

- Unnecessary overhead (both programmatically and in network traffic) in querying data

- Data providers are static and simple message passing, which SOAP provides, is sufficient

What is needed to participate?

Basic User

- Web Browser

Advanced User

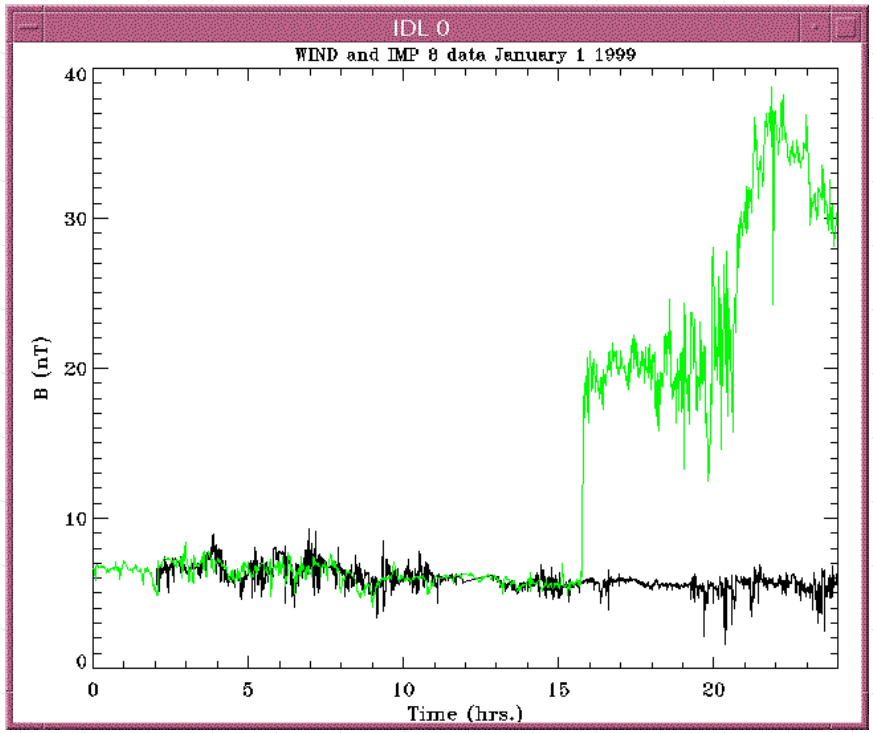
- Programming experience
- SOAP library (available for most languages – C, Perl, Java, etc.

Data Provider

- SOAP daemon – provided by VHO team
- SOAP library – available free online
- Perl XML software – available free from CPAN
- Query Engine – provided by VHO team

Future Plans

- Add more Heliospheric data sets and services
- Finalize prototype and distribute to PI sites
- Incorporate a "Heliosoft" library of analysis and reading routines
- Provide the community with a stand alone application which utilizes the full power of the VHO



Additional Information and Resources

- VHO home page – http://vho.nasa.gov
- VHO Prototype basic search page http://vho.nasa.gov/search.html
- VHO API information http://vho.nasa.gov/api.html
- VHO Advanced search and service documentation http://vho.nasa.gov/services.html